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Spin States and Structural Phases in Novel Superconducting Iron Pnictides

S. A. Kharlamova[1, 2, 3], S. L. Bud`ko[4], S. V. Sinogeikin[1, 2], and V.V. Struzhkin[1]

[1]Carnegie Institution of Washington, 5251 Broad Branch Rd. Washington, DC 20015
[2]Advanced Photon Source, Argonne National Laboratory, Argonne, IL 60439
[3]Kirenskii Institute of Physics, Siberian Division, Russian Academy of Sciences, Akademgorodok, Krasnoyarsk, 660036 Russia
[4]Ames Laboratory, Iowa State University, 111 TASF, Ames, IA 50011

Over the past few decades the understanding of the electronic structure of solids has become important now that it can be used as the basis for direct prediction of the entire range of dielectric and bonding properties of solids. Spin-crossover or valence transformation upon crystallographic phase transitions in many materials, especially in strong correlated electron systems takes place [1, 2]. Since the discovery of the cuprates some decades ago, the metal pnictides are considered as the second important class of high-T_c superconductors [3–5]. The pnictides having strong electron-electron correlations and show an interesting relationship between unconventional superconductivity and magnetism. Recently, we studied the local electronic structure of 3d transition of Fe ions in $SrFe_2As_2$ by x-ray emission spectroscopy [6]. The HS-LS spin crossover effect (high-spin low-spin transition) induced by high pressure at room temperature in the range 4–6 GPa is observed in $SrFe_2As_2$. We expect the most interesting processes at low temperatures. Changes in electronic and magnetic states are followed by or cause the change of interatomic distances and angle bonds.

Therefore, I will present our study of the structural and electronic phase transitions in $SrFe_2As_2$ at high pressures and low temperatures. To reveal the evolution of superconductivity and magnetism, the interplay between these two collective phenomena, electronic structures, and spin states in these materials we performed high-pressure, low-temperature studies of the $SrFe_2As_2$ using x-ray emission spectroscopy and x-ray diffraction. As a result of the study, we obtained the detailed crystal structure of $SrFe_2As_2$, the structural V-P phase diagram, and established the relationship between structural, electronic, and magnetic properties of the iron-arsenide superconductors.

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